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PATENT

SPECIFICATION



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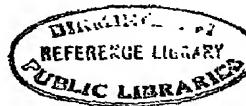
PROVISIONAL SPECIFICATION.

Improvements in or relating to Internal-combustion Engines.

We, EDWARD CLAUDE SHAKESPEARE CLENCH, A.M.I.Mech.E., A.M.I.A.E., Engineer, of The Aster Engineering Company (1913), Limited, and THE ASTER ENGINEERING COMPANY (1913), LIMITED, of Wembley, Middlesex, do hereby declare the nature of this invention to be as follows:—

- 5 This invention is for improvements in or relating to internal-combustion engines and has for its object to provide an engine which can be submerged without damage and if desired can be kept running under water.
It has been proposed to enclose internal-combustion engines in a sealed outer casing resembling a box into which the engine is placed, but such an arrangement has many objections in that the box, if made light, easily becomes damaged and is then liable to leak, and if made heavy enough to withstand damage, it adds greatly to the weight of the plant.
- 10 According to this invention the crank-chamber is closed but is provided with communication with the atmosphere above water-level, a side cover is provided to enclose the valve-mechanism which is arranged along one side of the engine in the usual manner, communication is made between the atmosphere at a point above water-level and this cover and also the intake of the carburettor, and the sparking-plugs are situated in the path of the air which is drawn into the carburettor whereby the said sparking-plugs are kept cool.
- 15 Preferably the carburettor is enclosed in a casing on the opposite side of the cylinders from that whereon the valve-mechanism is mounted. Moreover, the crank-chamber may be connected by a conduit with the said side cover so that its communication with the atmosphere is through the cover and the air-conduit connected therewith.
- 20 According to one method of carrying out this invention the multiple cylinders are built together in the usual manner side by side above the crank-chamber and on one side the valve-stems and tappet-rods are placed in a recess extending along the whole side and provided between the top of the crank-chamber and the usual overhanging portion of the cylinder-heads which constitute the valve-chambers. This whole side of the cylinders is enclosed with a detachable cover and the sparking-plugs are situated along the top of the cylinder-head within the said cover. Above the sparking-plugs the cover has an opening for the air-admission and a baffle is placed below the plugs so that the air coming in by the said openings shall be diverted along the plugs in both directions before passing further into the chamber formed by the enclosing cover and the recess wherein the valve-stem and tappet-rods are placed. The air-admission opening at the top of the cover is provided with means for securing
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[Price 6d.]



to it a conduit which can be run up to any height desired according to the depth of water to which the engine is expected to be submerged.

The carburettor is mounted in an independent water-tight case on the opposite side of the motor to that at which the said cover is situated, and the intake of the carburettor communicates with the interior of the cover by a conduit which forms a short connection between the carburettor and the ordinary jacket round the cylinders; a narrow but deep space is left between two cylinders and made to open into the valve-mechanism chamber so that air from within the cover of that chamber can pass to the intake of the carburettor. The induction conduit passes through a small chamber into which the exhaust is discharged so that the charge, as it is sucked into the cylinders, is heated by the exhaust and to this chamber a conduit can be connected and carried up above water-level for the escape of the exhaust.

The crank-case is entirely enclosed and a gland is provided at that end from which the crank-shaft projects for connection to the pump or other mechanism to be driven by the motor, but a conduit extends from the crank-chamber to the valve-gear chamber to allow the air to be pumped in and out of the crank-chamber as the pistons of the engine advance into or recede from it.

It will be appreciated that all the other parts of the engine are covered in by making the usual casing with which such parts are enclosed water-tight but the valve-mechanism cannot be made water-tight without a special cover because these parts would have to be made too tight to operate satisfactorily if all the valve-stems and tappet-rods were provided with glands.

Another element which requires to work freely and therefore cannot be operated through glands is the governor. This is conveniently mounted in a casing at the end of the crank-chamber. The governor operates upon a lever in the same casing and this is connected to a link which extends from the casing into the valve-mechanism chamber and thence is operatively connected to the throttle of the engine through the air-passage between the cylinders.

If desired, the ignition mechanism comprising a magneto, commutator, sparking-coil and accumulator can all be mounted in an auxiliary casing at the end of the crank-chamber and the governor may be enclosed in a separate casing within this auxiliary casing. The object of this is to prevent oil from getting on to the ignition apparatus from the governor, and the spindle to which the aforesaid arm is connected may project through the wall of the inner casing so that the arm and connecting-link of the governor lie in the auxiliary casing. The leads from the ignition apparatus can be carried through the wall of the auxiliary casing and the casing enclosing the cylinders in the same manner as the connecting-link for the governor is carried through. This casing does not necessarily lie flush against the casing of the cylinders and when this is not so, connecting-tubes may be provided between the two casings, one for the governor-link and the other for the leads.

If desired the conduit for supplying air to the engine and that for the exhaust may each be provided with a controlling-cock so that when the engine is to be submerged without being run, air may be pumped into the various chambers and the cocks closed whereby condensation will be prevented and should there be any slight leak the air escaping from the same will tend to keep the water out.

Dated this 14th day of June, 1917.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London, E.C. 1,
Chartered Patent Agents.

COMPLETE SPECIFICATION.

Improvements in or relating to Internal-combustion Engines.

We, EDWARD CLAUDE SHAKESPEARE CLENCH, A.M.I.Mech.E., A.M.I.A.E., Engineer, of The Aster Engineering Company (1913) Limited, and THE ASTER ENGINEERING COMPANY (1913) LIMITED, of Wembley, Middlesex, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to internal-combustion engines and has for its object to provide an engine which can be submerged without damage and if desired can be kept running under water.

10 It has been proposed to enclose internal-combustion engines in a sealed outer casing resembling a box into which the engine is placed, but such an arrangement has many objections in that the box, if made light, easily becomes damaged and is then liable to leak, and if made heavy enough to withstand damage, it adds greatly to the weight of the plant.

15 According to this invention, the crank-chamber is closed and made watertight, but is provided with communication with the atmosphere above water-level, a side cover is provided to enclose the valve-stems and tappets which are arranged along one side of the engine in the usual manner, communication is made between the atmosphere at a point above water-level and this side cover

20 and also with the intake of the carburettor, and the sparking-plugs are situated in the path of the air which is drawn into the carburettor whereby the said sparking-plugs are kept cool.

The crank-chamber may be connected by a conduit with the space enclosed by the side cover for the valve stems and tappets so that its communication with the atmosphere is through the said space and the air-conduit connected therewith.

In the accompanying drawings which illustrate one method of carrying out this invention:—

Figure 1 is an elevation of the engine viewed from one end of the crank-shaft;

Figure 2 is an elevation of the engine viewed from the right of Figure 1 with parts in section and the cover-plate for the valve-stems and tappets removed;

Figure 3 is a horizontal section on the line 3—3 of Figure 2, and

Figure 4 is a vertical section on the line 4—4 of Figure 3.

The same letters indicate the same parts throughout the drawings.

The multiple cylinders A are built together in the usual manner side-by-side above the crank-chamber B and on one side the valve-stems C and tappet-rods C¹ are placed in a recess A¹ extending along the whole side and provided between the top of the crank-chamber B and the usual overhanging portion A² of the cylinder-heads which constitutes the valve-chambers. This whole side of the cylinders is enclosed by a detachable cover A³ and the sparking-plugs D are situated along the top of the cylinder-head within the said cover. Above the sparking-plugs the cover has an opening A⁴ for air-admission and a baffle D¹ is placed below the plugs so that the air coming in by the said openings shall be diverted along the plugs in both directions before passing further into the chamber formed by the enclosing cover A³ and the recess wherein the valve-stem

and tappet-rods are placed. The air-admission opening A⁴ at the top of the cover is provided with a flange for securing to it a conduit which can be run up to any height desired according to the depth of water to which the engine is expected to be submerged.

The carburettor E is mounted within the cover A³ and its intake communicates freely with the chamber formed by the said cover. A narrow but deep space E¹ is left between the two cylinders and constitutes an air-conduit from the carburettor to the vaporizer E². The vaporizer may be of any known construction and therefore need not be described in detail in this specification, and the return from the vaporizer to the induction-valves A⁵ is effected by another 10 passage E³ between the cylinders which passage is similar to E¹.

The exhaust from the cylinders is passed round the vaporizer, connections for this purpose being made in any convenient manner and escapes by the outlet F. Conduits may be connected to the inlet A⁴ and to the outlet F and these conduits may be continued vertically to any desired height as hereinafter 15 further described.

The crank-case B is entirely enclosed and a gland B¹ is provided at that end from which the crank-shaft B² projects for connection to the pump or other mechanism to be driven by the motor, but a conduit B³ situated between the two cylinders extends from the crank-chamber to the valve-stem recess A¹ to 20 allow the air to be pumped in and out of the crank-chamber as the pistons of the engine advance into or recede from it.

It will be appreciated that all the other parts of the engine are covered in by making the usual casing with which such parts are enclosed watertight, but the tappet-rods and valve-steins cannot be made watertight without a special 25 cover because they would have to be made too tight to operate satisfactorily if they were provided with glands.

Another element which requires to work freely and therefore cannot be operated through glands is the governor. This is conveniently mounted in a casing G at the end of the crank-chamber. The governor operates upon a lever G¹ which lies outside the casing G and this is connected to a link G² which extends from the casing into the valve-mechanism chamber and thence 30 is operatively connected to the throttle of the engine.

The ignition mechanism, comprising a magneto H, commutator H¹, sparking-coil H², and accumulator H³ is all mounted in a further casing, hereinafter 35 called the ignition casing, J, which encloses the governor-casing G at the end of the crank-chamber. The object of this is to prevent oil from getting on to the ignition apparatus from the governor. The spindle G⁴ to which the governor-arm G¹ is connected projects through the wall of the inner casing G so that the arm and its connecting-link G² lie in the ignition casing J. The leads from the 40 ignition apparatus can be carried through the wall of the ignition casing, and the casing enclosing the cylinders, in the same manner as the connecting-link for the governor is carried through. This casing does not necessarily lie flush against the casing of the cylinders and when this is so, connecting-tubes J¹, J², are provided between the two casings, one for the governor-link and the other 45 for the leads.

When it is desired to keep the engine running whilst submerged, the conduits which it has been stated may be connected to the inlet- and outlet-openings A⁴ and F respectively, are carried up to such height as to have their ends above the level of the submerging liquid. If however, the motor is to be submerged idle, the conduits employed may be short and provided with cocks, or cocks may be placed direct on the openings A⁴ and F so that these openings can be readily closed when running is stopped and the whole interior of the casing can then be charged with air under pressure to prevent the formation of a vacuum as the engine cools down after use and to keep out liquid by the escape of the air through any small leakages which may be present. A further advantage of 50 charging the casing with air is that if any closure-plate has been omitted this 55

is discovered before submersion takes place by the fact that no pressure can be created in the chamber.

The engine-controls, that is, the mechanism for varying the firing-point, the means for controlling the throttle, and the means for operating the switches, 5 may be effected through finger-pieces mounted to have an angular movement in the casing. One of these devices is shown in Figure 1 where the hand-operated spindle K is provided with a milled head K¹ lying outside the casing, extends through a stuffing-box K² and has a conical bearing-piece K³ which fits a similarly shaped socket K⁴ fast on the side of the casing J. The spindle K has 10 the end which is within the casing attached to the control-mechanism for varying the firing-point, which mechanism in itself constitutes no part of the present invention and therefore need not be described in detail. It will be seen that with this arrangement leakage is prevented not only by the stuffing-box G² but also by the conical portion K³ and its surrounding socket K⁴. To keep the 15 conical portion in proper contact with the socket K⁴, a spring K⁵ is provided which thrusts at one end against the inner end of the socket K⁴ and at the other end against a collar K⁶ on the end of the spindle K.

Obviously a stuffing-box can be used for these control-members, and the 20 control-members can slide instead of rotate therein, but as they are small the form of the apparatus described is found to be convenient as applied to these parts. A similar device can be used for controlling the throttle and another such device for the switch for the firing-circuit.

It will be appreciated that the recess A¹ can be run along the whole side of a 25 multi-cylinder engine as a continuous recess and a single cover-plate provided therefor, or each cylinder-block may be provided with a separate recess and a separate cover whether such block contains one or more cylinders.

The tubes J¹, J², in addition to providing passages through which the leads 30 and the governor parts can be carried, afford interconnecting conduits for admitting air to all parts of the covering casings when the same is pumped into the casings to prevent the formation of a vacuum.

The vaporizer E² is surrounded by a casing E^{2*} to prevent the vaporizer from 35 being unduly chilled by the surrounding water when the engine is submerged and this can be connected to the crank-chamber or some other part by a conduit, so that air will find access to it when the whole is being charged with air under pressure.

Liquid fuel may be supplied to the engine by a flexible conduit from a fuel-tank above water-level, the conduit being provided with a pressure-reducing valve to prevent flooding of the carburettor due to variations of head, or a 40 totally-enclosed fuel-tank can be fitted on the engine and the displacement by the withdrawal of fuel made good by air from any part communicating with the air-supply. The crank-chamber is provided with sufficient lubrication for a ten-hour's run and therefore it is not usually necessary to arrange for supplying this form above the water-level and the cooling system is not open to communication with the surrounding water, so that water from outside is 45 pumped into the water-jacket and again pumped out into the surrounding water.

It has previously been proposed to provide an internal-combustion engine for attachment at the stern of a boat with the cylinder or cylinders in a horizontal 50 position and a propeller-shaft projecting from the end of the crank-case which is open to the atmosphere through a vertical hollow crank shaft. The recess for the valve-stems was covered in by a plate which constituted part of a water-jacket and the surrounding water had free access into the interior, so that the valve-stems had to be provided with glands. The carburettor and other parts for supplying air and fuel to the engine were situated above the water-level and 55 connected by a conduit extending down to the engine. No claim is made in the present specification for such a device.

Having now particularly described and ascertained the nature of our said

invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A submersible engine characterised in that the crank-chamber is closed and made watertight but is provided with communication with the atmosphere above water-level, a side cover is provided to enclose the valve-stems and tappets which are arranged along one side of the engine in the usual manner, communication is made between the atmosphere at a point above water-level and this side cover, and also that the intake of the carburettor and the sparking-plugs are situated in the path of the air which is drawn into the carburettor for the purpose described. 5

2. A submersible engine according to Claiming-clause No. 1, further characterised in that the carburettor is enclosed by the casing which covers in the recess for the valve-stems and tappets. 10

3. A submersible engine according to Claiming-clause No. 1 wherein the crank-chamber is connected by a conduit (for example B³) with the space enclosed by the side-cover for the valve-stems and tappets so that its communication with the atmosphere is through the said space and the air-conduit connected therewith. 15

4. A submersible engine according to Claiming-clause No. 2 characterised by the carburettor having communication with a vaporizer situated on the opposite side of the engine-cylinders through a passage which extends between the cylinders, with or without the return from the vaporizer to the induction-valves being similarly constituted by a passage between the cylinders. 20

5. A submersible engine according to Claiming-clause No. 1 characterised in that the ignition-mechanism such as the magneto, commutator, sparking-coil, and accumulators, is enclosed in an ignition-casing at the side of the crank-chamber in which the governor also is mounted but is separately enclosed to prevent oil from escaping thence to the ignition-mechanism, with or without an operating-member (for example G¹ G⁴) extending from the governor to the outside of its casing but lying within the surrounding ignition casing operatively-connected with the throttle (for example through a tube J¹) connecting the auxiliary casing with the space within which the valve-stems and tappets lie. 25

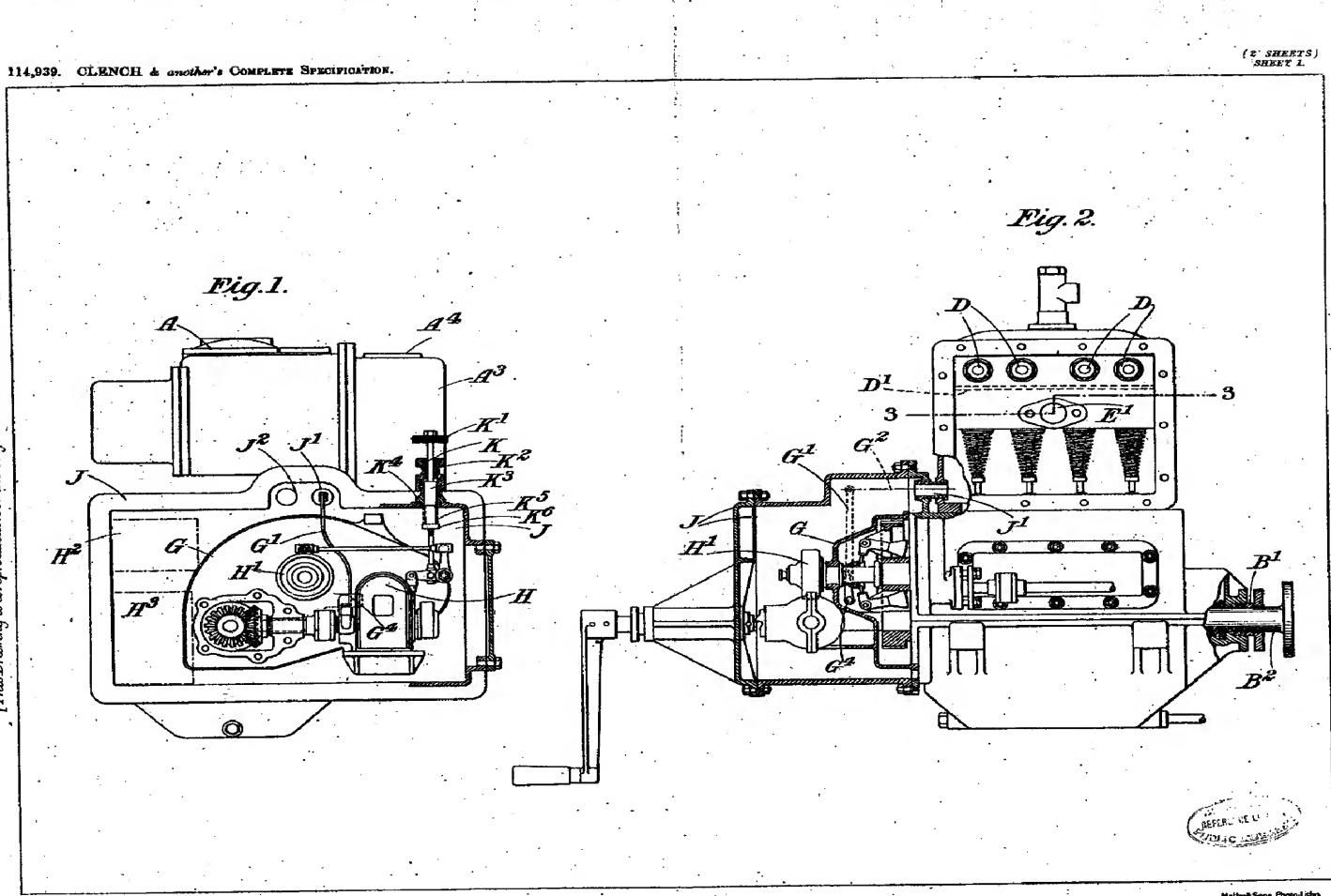
6. A submersible engine according to Claiming-clause No. 1 wherein the vaporizer is enclosed by an air-jacket to prevent undue cooling when the engine is submerged. 30

7. The submersible engine as described and illustrated in the accompanying drawings. 35

Dated this 13th day of December, 1917.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London, E.C. 1,
Chartered Patent Agents. 40

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[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

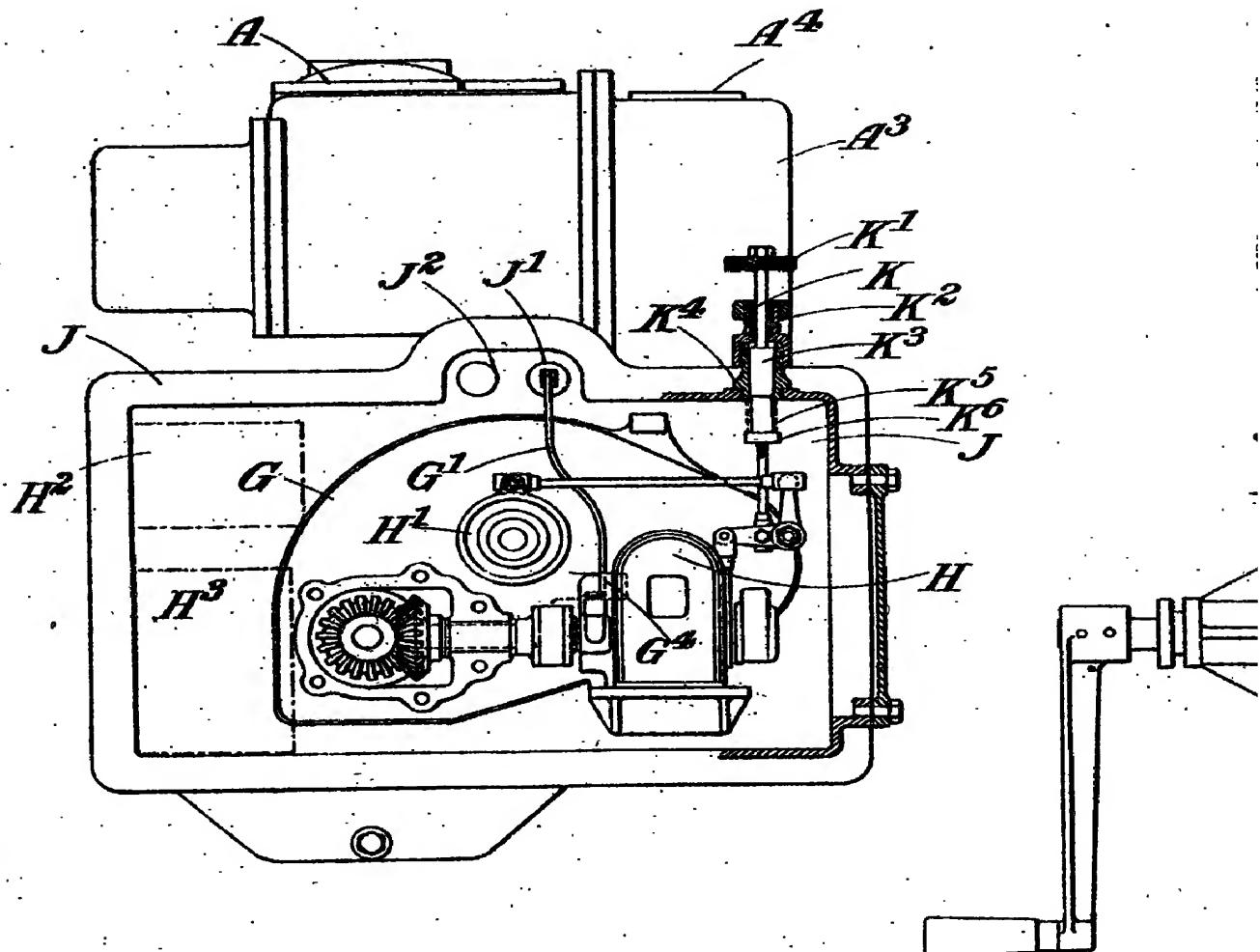
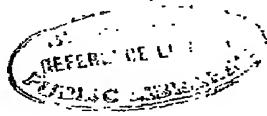
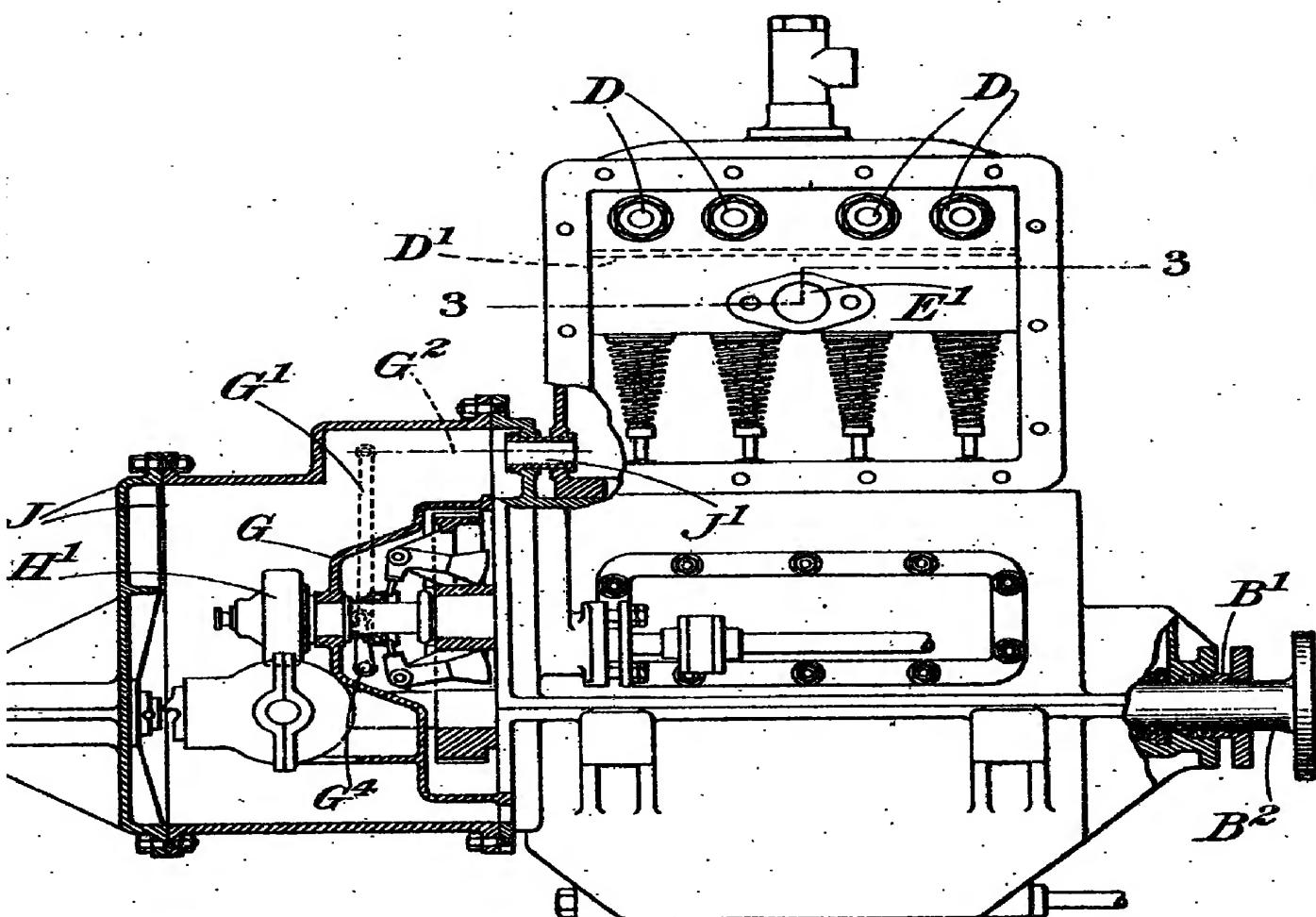


Fig. 2.



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(2 SHEETS)
SHEET 2.

Fig. 3.

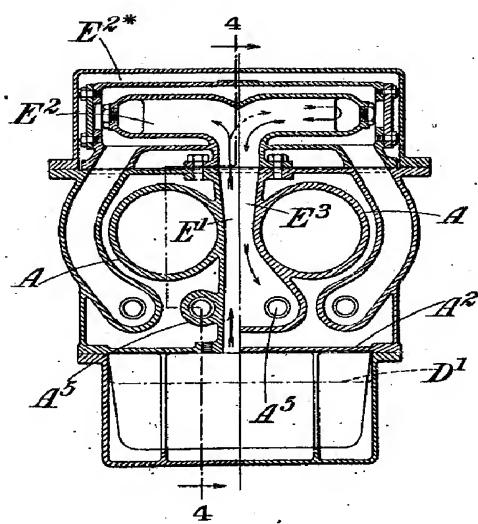
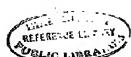
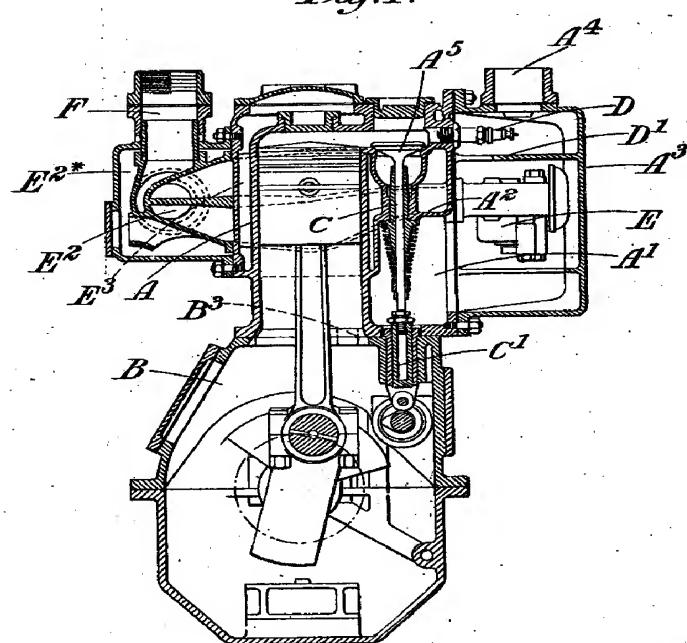


Fig. 4.



McGraw-Hill Photo-Litho

[This Drawing is a full-size reproduction of the Original.]

Fig. 3.

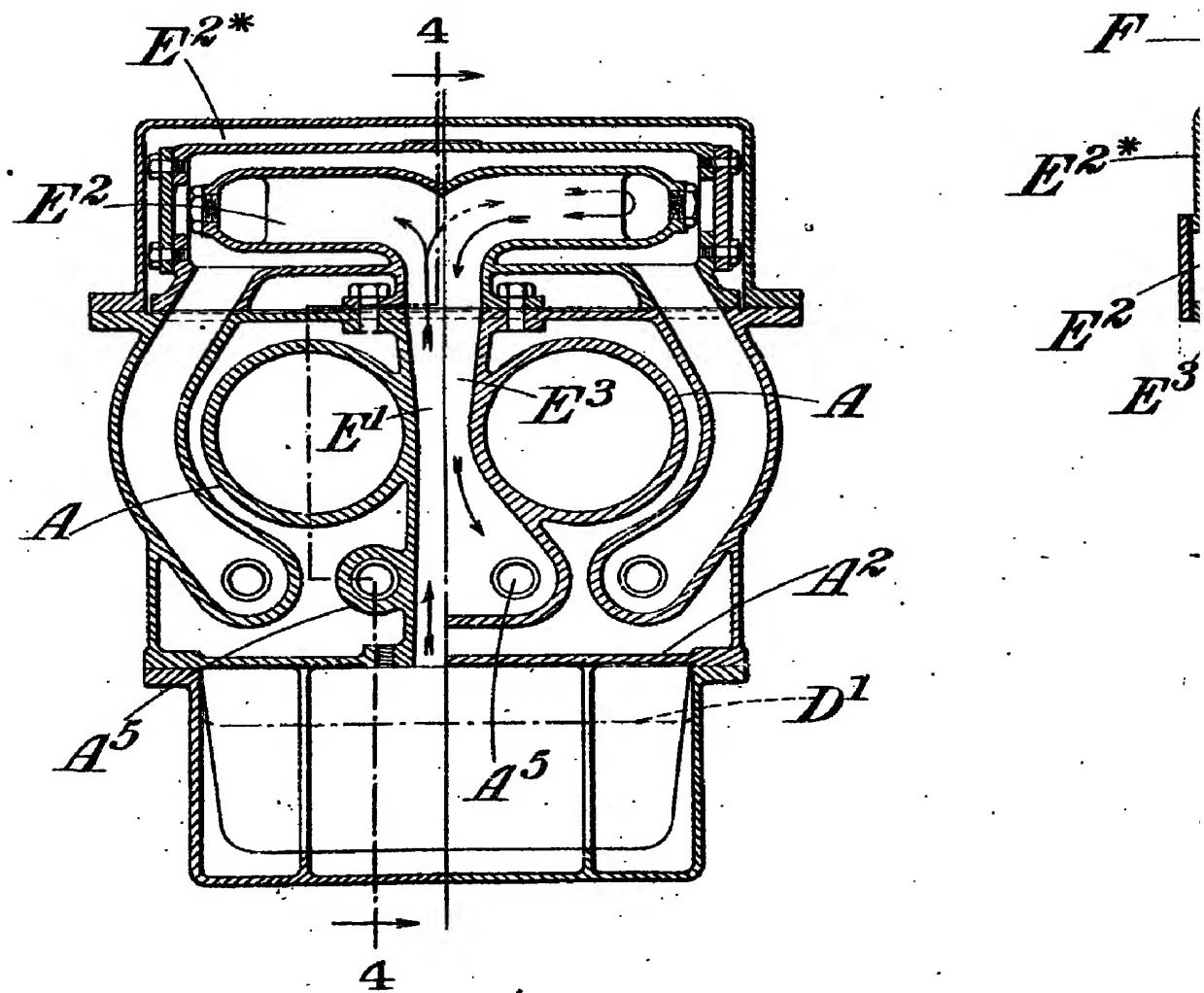


Fig. 4.

